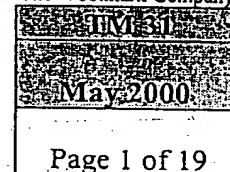


#8

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WOOLMARK TEST METHOD:

WASHING OF WOOL TEXTILE PRODUCTS

1 SCOPE

This test method is applicable to all washable (hand wash or machine wash) wool textile products. The test may be used to determine the relaxation dimensional change, felting shrinkage and total shrinkage of washable wool textile products.

The test method is based on ISO 6330.

2 PRINCIPLE

Shrinkage of washable products is assessed using the International Standards Organisation standard ISO 6330 5A and 7A wash cycle programmes, as appropriate, with the load reduced to 1kg for both programmes.

3 DEFINITIONS

For the purposes of this test method, the following definitions apply:-

Dimensional Change

A change in length or width of a fabric specimen.

Extension

The increase in length and/or width induced by washing, *expressed as a positive (+) dimensional change.*

Shrinkage

The reduction in length and/or width induced by washing, *expressed as a negative (-) dimensional change.*

Relaxation

The dimensional change caused by the release of strains introduced during manufacture, assessed after the initial wash cycle.

Felting Shrinkage

Irreversible shrinkage caused by progressive entanglement of the wool fibres induced by washing in an aqueous solution.

Total Shrinkage

The sum of relaxation and felting shrinkage.

Cuff Dimensional Change

The dimensional change measured along a fold in the width or length direction.

Cuff Edge Differential

The difference between the felting shrinkage at the cuff and the felting shrinkage in either length or width direction.

Hand Washable

A wool textile material that can be satisfactorily hand washed for the required wash/wear life.

Machine Washable

A wool textile material that can be satisfactorily washed in a domestic washing machine wool wash cycle for the required wash/wear life.

4 APPARATUS AND MATERIALS

4.1 Wascator (see 13.1)

Model FOM 71 Special or Microprocessor Laboratory washing machine and programme cards/microchip for the ISO 6330 7A and 5A wash programmes.

4.2 Ballast, SM37 (see 13.2)

Pieces consisting of two layers of knitted polyester fabric, each $30 \times 30 \pm 3$ cm square and of mass 35 ± 3 g, sewn together at the edges.

4.3 Detergent, SM 49 (see 13.2)

As specified in Annex B of ISO 6330 IEC Detergent B, without optical brightening agent and sodium perborate.

4.4 Metal linear scale

Accurately graduated in 1 mm divisions.

4.5 Conditioning Apparatus

Means shall be provided for producing atmospheres for conditioning as specified in Section 5.

4.6 Apparatus for converting intermediate products into test specimens.

4.6.1 Spinning Equipment

A pin drafter suitable for producing a 2.8 ktex sliver. A spinning frame and doubling unit capable of producing a yarn from that sliver to the appropriate count (see Appendix 1).

4.6.2 Knitting Machine

A knitting machine capable of producing a plain knit fabric of the appropriate cover factor (see Appendix 1).

4.6.3 Loop Length Measuring Device (see 13.3)

Suitable apparatus are the Shirley Crimp Tester or HATRA course length tester.

4.7 Measuring tray

Approximately 500 x 500 mm suitable for wet measurement

4.8 Oven

An oven for drying capable of maintaining 50 ± 5 C

4.9 Reference Knitted Fabric Standards for Total Easy Care Knitwear SM64 (see 13.4).

Knitted standards to evaluate the surface appearance change of knitwear after washing and tumble drying

4.10 Reference Woven Fabric Smoothness Photographs for Machine Washable, Flat Hang or Tumble Dry Woven Fabrics SM 65 (see 13.4).

Photographic standards for evaluating woven fabric smoothness after washing and drying.

5 STANDARD ATMOSPHERES

5.1 The standard atmosphere for pre-conditioning is:-

Relative Humidity: 10%

Temperature: 50 C

5.2 The standard atmosphere for conditioning and testing is:-

Relative Humidity: $65 \pm 2\%$

Temperature: 20 ± 2

Conditioning shall take place starting with the specimen on the dry side.

6 TEST SPECIMEN

6.1 Hand and Machine Knitting Yarns

The yarn should be knitted as described in Appendix 1, Section 1.3. The test specimen is then prepared as described in Section 6.2.

NOTE 1: HAND AND MACHINE WASHABLE YARNS : Following knitting, the test specimen **MUST** be given 1 x 7A wash cycle before testing.

6.2 Knitted Fabric (not including garments)

6.2.1 For samples produced according to Appendix 1, or supplied from a knitter in fabric form, the test specimen shall be of double thickness with a preferred size of 300 x 400 mm. If necessary the sample size may be reduced but must never be less than 225 x 300 mm. In all cases the ratio of 3:4 (width : length) must be observed, the longer length being in the direction in which the specimen has been produced, ie the direction of the wales.

NOTE 2: Samples in excess of 300 x 400 mm are not desirable since their higher weight reduces the number of specimens which may be tested in the machine.

6.2.2 The free edges must be sewn together with a dimensionally stable thread (eg polyester). In cases where unravelling is possible, an overlock stitch should be used on the edges of the specimen. Alternatively the sample may be turned inside out prior to sewing; before sewing the last few centimetres the sample should be turned the correct way out. Care shall be taken to avoid distortion of the sample during sewing.

6.2.3 Mark the test specimens to allow three separate measurements in each direction (Fig 1). These marks must be placed not less than 25 mm from the edge of the specimen. Indicate the direction in which the specimen has been produced (the wale direction) by means of an arrow.

NOTE 3: Unfinished "KNITTED FABRIC, MADE FROM HAND AND MACHINE WASHABLE YARNS". The test specimen **MUST** be given 1 x 7A cycle before testing.

6.3 Sweaters and Cardigans

- 6.3.1 Measurement required by Woolmark/Woolmark Blend specifications. The back of the garment must be marked to allow three measurements in the length and three measurements in the width direction (Fig 2). These marks shall be placed not less than 25 mm from the side seam.

NOTE 4: Knitted garments must be turned inside out before washing.

6.3.2 Additional measurements.

Many retailers have their own in-house specifications which must be met in addition to Woolmark/Woolmark Blend requirements. It is common for such specifications to refer to measurements (a_1), (a_2), (l) and (w) shown in Fig 2.

6.4 Socks and Stockings

The product must be marked to allow four separate measurements in the length direction only, i.e. two on the leg and two on the foot (Fig 3). The marks must be placed not less than 25 mm (if possible) from any point where fashioning takes place. The marks must not be less than 10 mm from the fold.

6.5 Gloves

Three pairs of marks must be placed on the glove in the width direction and two pairs of marks in the length direction using similar guidelines to those provided in 6.4.

NOTE 5: If the shape of the gloves does not allow 3 pairs of marks in the length and width, mark as reasonably practical.

6.6 Woven Fabric (not including garments)

- 6.6.1 Woven fabric specimens shall measure 500 x 500 mm. The edges of the specimen shall preferably be overlocked to prevent fraying

- 6.6.2 Form a "cuff" in the warp and weft directions on the sample originally measuring 500 x 500mm, by folding two sides of the samples along lines 40 mm from the edge (Fig 4), with the face of the fabric to the outside.

The sample shall be pressed or ironed on these lines and sewn 30 - 35 mm from the "cuff" using a chain stitch or lockstitch.

- 6.6.4 Mark both the warp and weft "cuff" on the fold line such that measurement is unaffected by the sample edge or the seam line (Fig 4).

6.7 Preparation of Woven Fabric into a Trouser Leg (for experimental evaluation of woven fabrics only).

- 6.7.1 Cut two specimens 500 mm in the warp direction and 500 mm in the weft direction.
- 6.7.2 Place the two specimens together with the face of the fabric on the inside and sew a seam at each side in the longer direction, 25 mm from the edges of the fabric to form a trouser leg. Press the seams open.
- 6.7.3 Form a cuff by folding one end of the leg 40 mm from the edge (the face of the fabric to the outside). Press the cuff and then sew around the cuff 30-35 mm from the cuff fold using a chain stitch.
- 6.7.4 Turn the face of the fabric to the outside and press the prepared trouser leg to give a crease at each side, with the seams central.
- 6.7.5 Mark the specimens to allow three separate measurements in each direction from crease to crease. Mark the cuff as shown in Figure 5b measurement (c).
- 6.7.6 After conditioning and measuring as described in section 7, but before washing, offset the creases by 25 mm and secure to fix in position.

6.8 Trousers (Woven or Knitted)

The garments shall be marked as shown in Figs 5a and 5b at the waist (a), knee (b), cuff (c), outside leg seam (d_1 and d_2) of both legs, and inside leg seam (e_1 and e_2) of both legs. Measurement (f) is only required if the trouser has a turned up cuff.

6.9 Skirts (Woven or Knitted)

The front of the garment shall be marked as shown in Figure 7 at the waist (a), width (b), hem (c) and length (d).

NOTE 6: Width (b) measurements should be the width of the panel and placed half way between the bottom of the hem and the bottom of the waistband. If the panels are less than 25 cm wide, more than one panel width must be included in the 30 cm measurement.

6.10 Bedding Products

- 6.10.1 A full adult single bed size product should be tested.

NOTE 7: If a full adult single bed product is not available the minimum size shall be 100x100 cm.

- 6.10.2 The measured dimensions of the sample are used; marks must be applied to allow three measurements in the length and three in the width direction. Marks must be applied to the edge of the sample, but shall not be less than 50 mm from any corner.

7 SPECIMEN CONDITIONING AND INITIAL MEASUREMENT

- 7.1 Mark the test specimens as indicated in the appropriate sub-section of clause 6.
- 7.2 Specimens should be left flat, singly for a minimum of 24 hours in the standard atmosphere (see 5.2), prior to the test for conditioning.

7.3 Original Measurement: (OM)

The untested conditioned sample measurements shall be taken at the appropriate points marked (see Figs 1-7).

NOTE 8: Measure from centre to centre of the marks.

- 7.4 Calculate separately the mean of the measurements in each direction and use these values for subsequent shrinkage calculations
- 7.5 In the case of "cuff edge", measure the distance between the two marks on each of the cuff edge fold lines (see Fig 4 and 5b).

8 RELAXATION PROCEDURE

- 8.1 Weigh the test specimen and add sufficient SM 37 ballast (see 4.2) to give a total wash load of 1 kg. Not more than half the load shall be made up of test samples EXCEPT where a single sample alone exceeds 0.5 kg. Where a single sample exceeds 1 kg it forms the complete load without the addition of ballast. Place the wash load in the Wascator.
- 8.2 Dissolve the recommended amount of SM 49 detergent (see 14.1) in water at a temperature not exceeding 50 C. Add the detergent solution to the Wascator during the first water fill, when the water level is above the bottom of the washing drum.
- 8.3 Set the temperature of the wash cycle to $40 \pm 2^{\circ}\text{C}$.
- 8.4 Carry out one 7A wash cycle as specified in Appendix 2.

8.5 Remove the test specimen after the wash cycle and dry as specified in section 10 according to the care claim.

8.6 Condition the test specimen (see 5.2) unless otherwise agreed (without conditioning is a non-standard procedure and must be reported: see 12.7), and remeasure the points in 7.3.

8.7 **Relaxed Measurement: (RM)**
The washed sample measurements shall be taken at the appropriate points following the 1 x 7A wash cycle, drying and conditioning. Re-measure the points measured in 7.3.

9 FELTING PROCEDURE

9.1 Weigh the test specimen and add sufficient SM 37 ballast (see 4.2) to give a total wash load of 1 kg. Not more than half the load shall be made up of test samples EXCEPT where a single sample alone exceeds 0.5 kg. Where a single sample exceeds 1 kg it forms the complete load without the addition of ballast. Place the wash load in the Wascator.

9.2 Dissolve the recommended amount of SM 49 detergent (see 14.1) shall be dissolved in water at a temperature not exceeding 50 C. Add the detergent solution to the Wascator during the first water fill, when the water level is above the bottom of washing drum.

NOTE 9: If it is required to carry out more than one washing cycle, a fresh solution of detergent must be added at the beginning of each new wash cycle.

9.3 Set the temperature of the washing machine to 40 ± 2 C.

9.4 Carry out the appropriate number and type of wash cycles as specified in Appendix 2.

NOTE 10: Refer to the appropriate product specification sheet to obtain the correct information regarding the number and type of wash cycles to be used.

9.5 Remove the test specimen after the appropriate number and type of wash cycle(s) and dry as specified in section 10 according to the care claim.

9.6 Condition the test specimen (as specified in 5.2), and remeasure the points marked in 7.3.

9.7 **Felted Measurement (FM)**

The washed sample measurements shall be taken at the appropriate points following the final wash cycle, drying and conditioning.

10 **DRYING**

10.1 **Flat Dry (all products except tailored garments and blankets)**

Place the sample flat, singly, on a mesh tray or screen and gently remove wrinkles without stretching. Place the mesh tray or screen in an oven at the standard atmosphere for preconditioning (see 5.1) until dry.

10.2 **Hang Dry (all tailored garments and blankets)**

Products shall be hang dried as follows:-

Trousers and skirts shall be hang dried by the waist band and secured at two points.

Blankets shall be hang dried by folding over the line and secured at two points.

10.3 **Tumble Dry**

All fabrics and garments must be tumble dried according to Woolmark TM 254.

NOTE 11: If samples require afterwash appearance assessment, this must be carried out according to TM 206 for knitted's and TM 281 for woven's. The 'Reference Standards for Total Easy Care Knitwear' (SM64) and Washable Woven Fabrics (SM65) must be used to assess the appearance change after washing and drying.

11 **CALCULATIONS**

11.1 Calculate the mean width (WS) and length (LS) relaxation dimensional change, felting and total shrinkages separately using the following formulae:

$$\text{Relaxation dimensional change (\%)} = \frac{(RM - OM)}{OM} \times 100$$

$$\text{Felting Shrinkage (\%)} = \frac{(FM - RM)}{RM} \times 100$$

$$\text{Total Shrinkage (\%)} = \frac{(FM - OM)}{OM} \times 100$$

where: OM = Original Measurements
RM = Relaxed Measurements
FM = Felted Measurements

NOTE 12: If the shrinkage values are above the permitted specifications, but there is no evidence of felting, samples must be hand steam ironed on the two dot setting after the appropriate number of wash cycles. Re-measure after drying, ironing and reconditioning.

USE ONLY A DOMESTIC HAND STEAM IRON IN THE WEIGHT RANGE 1.0 TO 2.0 kg. DO NOT IRON IF THERE IS EVIDENCE OF FELTING (AREA FELTING OR "CUFF EDGE" FELTING).

NOTE 13: All measurements used in the calculations are means of length or width measurements.

11.2 Calculate, as necessary, the 'Area Dimensional Change' from the respective width and length dimensional change as indicated below:

$$\text{Area Dimensional Change (\%)} = WS + LS - \left(\frac{WS \times LS}{100} \right)$$

where: WS = Mean Width dimensional change (%)
LS = Mean Length dimensional change (%)

NOTE 14: Shrinkage is recorded as a negative (-) figure and extension as a positive (+) figure.

NOTE 15: The correction factor $\frac{WS \times LS}{100}$ is applied to compensate for the shaded area shown in Fig 8.

11.3 Calculate the cuff dimensional change (CS) and edge differential dimensional change width and length separately using the following formulae:-

$$\text{Cuff dimensional change (\%)} = \frac{FCM - RCM}{RCM} \times 100$$

$$\text{Edge Differential dimensional change (\%)} = CS - WS \text{ or } CS - LS$$

where: RCM = Relaxed cuff measurement
FCM = Felted cuff measurement
WS = Width dimensional change
LS = Length dimensional change
CS = Cuff dimensional change in Length
or Width

NOTE 16: The measurements of garments are defined as follows:-

Length -trouser outside leg (both legs)
-skirt length

Width -trousers knee * and waist
-skirt waist or panel *

* See Diagrams on Pages 16 to 17
These measurements should be used when calculating Edge
Differential dimensional change.

12 REPORT

- 12.1 Report that the test(s) was carried out according to Woolmark TM 31.
- 12.2.1 Report the length, width and area relaxation dimensional change (as applicable) as percentages.
- 12.3 Report the length, width and area felting shrinkage (as applicable) as percentages.
- 12.4 Report the length, width and area total dimensional change (as applicable) as percentages.
- 12.5 Report length and width edge differential shrinkages (as applicable) as a percentage
- 12.6 Report the number of ISO 6330 5A and/or 7A wash cycles carried out.
- 12.7 Report any deviation from the procedure described (eg no conditioning before measurement).

13 APPARATUS AND MATERIAL SUPPLIERS

- 13.1 The 'Wascator FOM 71 Special and Microprocessor Laboratory Washing Machines' may be obtained from:

Electrolux-Wascator
P.O. Box 87
S-341 00 Ljungby
Sweden

Tel: 00 46 372 66313
Fax: 00 46 372 13390

- 13.2 SM 37 polyester ballast, and SM 49 reference detergent are available from:

The Society of Dyers and Colourists
PO Box 244,
Perkin House,
82 Grattan Road,
BRADFORD BD1 2JB
United Kingdom

Tel: 00 44 (0) 1274 725138
Fax: 00 44 (0) 1274 392888

- 13.3 The 'Shirley Crimp Tester' and the 'HATRA Course Length Tester' may be obtained from:

SDL International Ltd
PO Box 162
Crown Royal
Shawcross Street
Stockport SK1 3JW
United Kingdom

Tel: 00 44 (0) 161 480 8485
Fax: 00 44 (0) 161 480 8580

- 13.4 SM64 Reference Knitted Fabric Standards for Total Easy Care Knitwear and SM65 Woven Fabric Smoothness photographs for Washable Woven Fabrics may be obtained from:

Testex
Development Centre
Valley Drive
ILKLEY
West Yorkshire
LS29 8PB
United Kingdom

Tel : 00 44 (0) 1943 601033
Fax : 00 44 (0) 1943 601415

e-mail: testex@wool.com

14 WATER HARDNESS

- 14.1 Before carrying out any washing cycle the water hardness shall be measured using a total hardness determination kit with a precision dropper.

Ensure that at the end of the suds portion of the washing stage, the suds height is approximately 2-3 cm.

The following guide for detergent concentration for all wash cycles shall be used:-

ppm CaCO_3	Detergent (SM 49)	Concentration (gl^{-1})
	7A Cycle	5A Cycle
0 - 20	1.0	0.3
20 - 90	1.0	1.0
90 - 150	2.0	2.0
> 150	3.0	3.0

NOTE 17: These recommendations should only be treated as guidelines since other components of "water hardness" can also influence sud formation, and therefore the rate and degree of shrinkage of wool during testing.

- 14.2 It has been decided that the use of SM 49 without Optical Brightening Agent and Sodium perborate is the most practical method of measuring dimensional change during machine washing. The sodium perborate has been omitted because there are a number of machine compatible detergents available for the wool wash which do not contain sodium perborate and also because new bleaching systems are being developed by the detergent industry.
- 14.3 The measurement of specimens between cycles is acceptable for diagnostic purposes.

Fig 1 KNITTED FABRIC

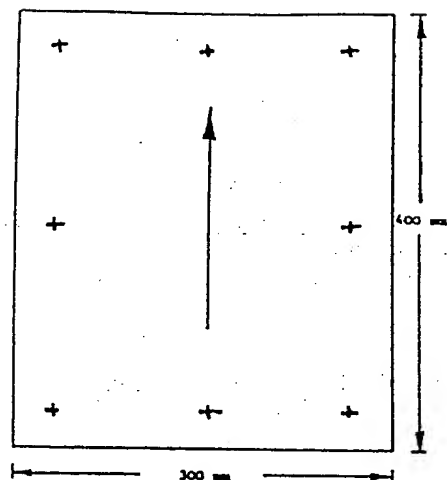


Fig 2 SWEATERS AND CARDIGANS

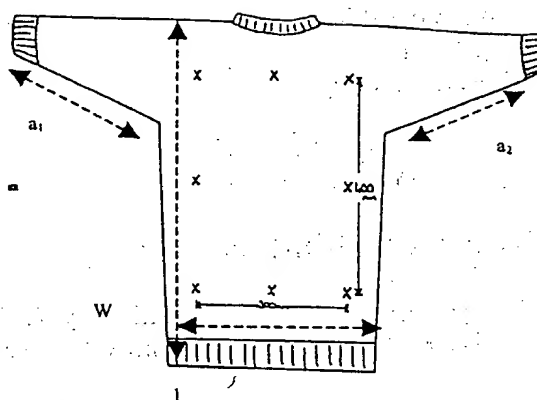


Fig 3 SOCKS

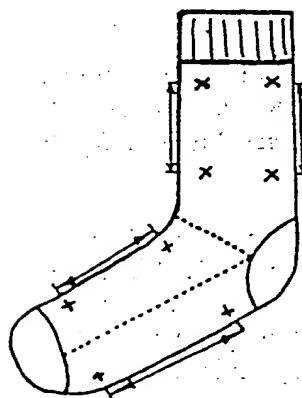


Fig 4 WOVEN FABRIC

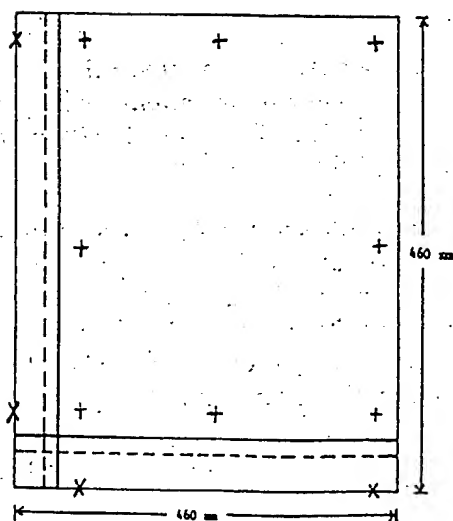


Fig 5a TROUSERS (WOVEN OR KNITTED)

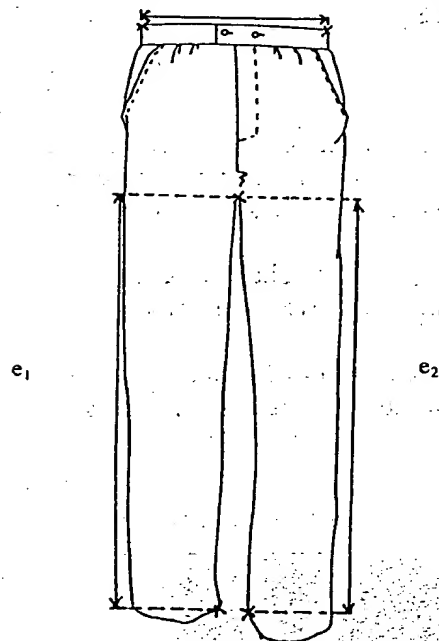


Fig 5b

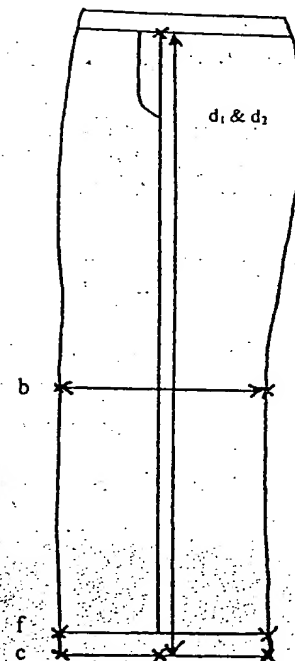


Fig 6 CORRECTION FACTOR

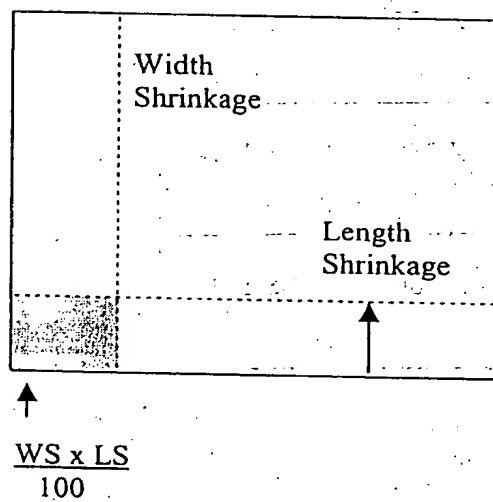
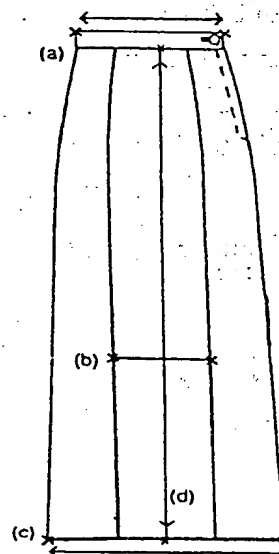


Fig 7 SKIRTS (WOVEN OR KNITTED) FACTOR



APPENDIX 1

1 PREPARATION OF INTERMEDIATE PRODUCTS

1.1 Preparation of Yarns from Loose Stock

When the sample has been shrink-resist treated in loose stock form, and if sample spinning facilities exist, a suitably sized representative sample blend should be prepared with lubricant, carded, spun and folded at the specified levels (see Table 1).

When sample spinning facilities do not exist, a sample of slubbing shall be taken from the bulk carding and a sample spun and twisted at the specified level (see Table 1).

NOTE A1: In the case where sample preparation machinery is used, this may not fully reflect bulk production due to unavoidable differences in production parameters.

TABLE 1: WOOLLEN YARNS

FIBRE DIAMETER	Count		Twist (tpm)	
	Lex	Metric (Nm)	Singles (Ne)	Folded
Coarser than 24 microns	222/2	2/9's	Z 225	S 129
22 – 24 microns	143/2	2/14's	Z 280	S 161
Finer than 22 microns	125/2	2/16's	Z 300	S 173

*tpm = turns per metre

1.2 Preparation of Yarns from Wool Top

When the sample provided is a top, draft the material on the pin drafter (see 4.6.1) to obtain a sliver of 2.8 ktex. Spin the sliver on the spinning frame and double it to obtain one of the standard two-fold yarns specified in Table 2.

TABLE 2: WORSTED YARNS

FIBRE DIAMETER	Count		Twist (tpm)	
	Itex	Metric (Nm)	Singles	Folded
25 micron or coarser	364/2	2/5.5's	Z 164	S 94.5
Finer than 25 micron	71/2	2/28's	Z 370	S 213

* tpm = turns per metre

1.3 Knitting of Yarn

When the sample is in yarn form (whether spun according to the requirements of Table 1 or Table 2 or supplied for a spinner), knit the yarn on the knitting machine (4.6.2) to the required cover factor. (Tables 3 and 4).

Knit the fabric and make appropriate adjustments to the loop length such that the cover factor as described in Woolmark TM 169 is produced to within $\pm 3\%$ of the values indicated in Tables 1 and 2.

TABLE 3: WOOLLEN YARNS

Cover Factor Units	Coarse Yarns ie 2/9's Nm	Fine Yarns ie 2/14's Nm
Inches worsted	0.85	1.0
cm metric	0.31	0.37
mm. tex	1.00	1.17

TABLE 4: WORSTED YARNS

Cover Factor Units	Coarse Yarns ie 2/5.5's Nm	Fine Yarns ie 2/28's Nm
Inches worsted	1.0	1.1
cm metric	0.37	0.41
mm. tex	1.17	1.29

NOTE A2: If yarns finer than 2/28 Nm will not knit at a cover factor of 1.1 inches worsted, two ends should be run as one in order to achieve the desired cover factor.

NOTE A3: If yarns coarser than 2/5.5 Nm will not knit at a cover factor of 0.85 inches worsted then knit to the most appropriate cover factor.

APPENDIX 2

Washing procedures for Wascator

Cycle	Agitation during heating, washing and rinsing	Washing			Rinse 1			Rinse 2			Rinse 3			Rinse 4		
		Temperature	Liquor level	Washing time at temperature	Cool down	Liquor level	Rinse time	Liquor level	Rinse time	Spin time	Liquor level	Rinse time	Spin time	Liquor level	Rinse time	Spin time
			cm	min		cm	min	cm	min	cm	cm	min	min	cm	min	min
1A	Normal	92 ± 3	10	12	Yes	13	3	13	3	1	13	2	1	13	2	6
2A	Normal	60 ± 3	10	12	Yes	13	3	13	3	1	13	2	1	13	2	6
3A	Gentle	60 ± 3	10	8	Yes	13	3	13	3	-	13	2	1	13	2	2 or drip dry
4A	Gentle	50 ± 3	10	8	Yes	13	3	13	3	-	13	2	1	13	2	2 or drip dry
5A	Normal	40 ± 3	10	12	No	13	3	13	3	1	13	2	1	13	2	6
6A	Gentle	40 ± 3	13	6	No	13	3	13	3	-	13	2	1	13	2	2 or drip dry
7A	Gentle	40 ± 3	13	3	No	13	3	13	3	1	13	2	6			
8A	Gentle	30 ± 3	13	3	No	13	3	13	3	-	13	2	2			
9A	Gentle	92 ± 3	10	8	Yes	13	3	13	3	-	13	2	-	13	2	2 or drip dry

